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# The Self-Determination Inventory: Student Report American Sign Language Translation

Carrie Lou Garberoglio[1,*], Daria Gerasimova[2], Karrie A. Shogren[2], Jeffrey Levi Palmer[1], Paige M. Johnson[1], Claire Ryan[1], Jesse R. Pace[2], Tyler Hicks[2], Kaitlyn Millen[2], Jennifer Higgins[1] and Stephanie W. Cawthon[1]

[1]University of Texas at Austin
[2]University of Kansas at Lawrence
*Correspondence should be addressed to Carrie Lou Garberoglio, College of Education, SZB 5.110, 1912 Speedway, D4900, Austin, TX 78712. E-mail: carrielou@utexas.edu

## Abstract

Research literature and community narratives both emphasize the importance of self-determination in the lives of deaf youth. This paper describes the development, initial validation, and potential applications of a translated measure of self-determination for deaf youth, the SDI:SR ASL Translation (SDI:SR ASL). A sample of 3,309 young people who completed the SDI:SR, of whom 392 were deaf, was used in this validation study. Results provide preliminary support for the use of SDI:SR ASL with deaf youth. Findings also indicate that deaf youth who take the SDI:SR ASL score more similarly to youth without disabilities taking the SDI:SR than youth with disabilities. The SDI:SR ASL can be an important tool for researchers and practitioners to better understand self-determination among deaf youth and facilitate continued development of self-determination skills.

The importance of promoting the development and expression of self-determination has received significant attention for youth (Shogren, Wehmeyer, & Lane, 2016) including disabled youth (Shogren & Ward, 2018) and deaf youth (Luckner & Sebald, 2013; Millen, 2020). Researchers have established a positive relationship between self-determination and postschool outcomes (Shogren & Shaw, 2016; Shogren, Wehmeyer, Palmer, Rifenbark, et al., 2015). Additional research has explored the role of self-determination for deaf youth as they navigate life after high school. For example, stronger self-determination and autonomous motivations in deaf youth increased the likelihood of living independently, college enrollment, higher wages, and opportunities for college advancement (Garberoglio, Schoffstall, Cawthon, Bond, & Caemmerer, 2017; Garberoglio, Schoffstall, Cawthon, Bond, & Ge, 2014).

## Self-Determination among Deaf Youth

Understanding the role of self-determination for deaf adolescents and young adults requires an examination of the contexts which deaf people navigate. Outcome disparities in the realms of education, employment, health, and quality of life have been observed in deaf individuals when compared with the hearing population (Barnett, McKee, Smith, & Pearson, 2011; Kushalnager, Ryan, et al., 2020; Palmer, Newman, Davidson, & Cawthon, 2020). These gaps are not the result of deafness, but demonstrate widespread system-level barriers and biases. As deaf youth transition into life after high school, they are faced with numerous barriers stemming from limited access to communication, negative attitudes and biases, and a lack of qualified and experienced professionals (National Deaf Center, 2018). In light of these barriers, two things are important to recognize: (1) self-determination skills are essential for overcoming the hurdles which are present in deaf young people's lives, and (2) the development of self-determination skills may be impeded as a result of structural barriers present in the lives of deaf young people.

First, narratives within deaf communities often point to the importance of self-determination skills, including self-advocacy, for navigating life as a deaf person and staying resilient throughout barriers that are often faced (Braun, Gormally, & Clark, 2017; Garberoglio, Guerra, Sanders, & Cawthon, 2020). Professionals that work with deaf youth also believe that self-determination skills are an important component in the successful transition for deaf youth (Luckner & Becker, 2013; Millen, Dorn, & Luckner, 2019; Reynolds, 2020). Although research involving deaf populations that explore self-determination as a construct is sparse, many of the sub domains falling under self-determination have been linked to important outcomes in the lives of deaf individuals. For example, self-advocacy skills are linked to greater

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quality of life, agency, and overall well-being (Schoffstall & Cawthon, 2013) and autonomous motivation increases the likelihood of career advancement opportunities and earning higher wages (Garberoglio et al., 2017). These findings are in alignment with what has emerged among other disability communities related to self-determination being linked to a range of postsecondary outcomes such as a greater sense of control over one's life and their environment, an important factor linked to better quality of life and well-being (Shogren et al., 2016; Wehmeyer, 1992.

Second, the development of self-determination does not occur in a vacuum. Self-determination development requires actual opportunities to acquire these skills, and to apply these skills (Shogren et al., 2015). Due to communication barriers and reduced social opportunities, deaf people may have fewer opportunities to acquire and apply self-determination skills in contexts that are accessible to them. Accessible opportunities to develop self-determination skills are crucial for ensuring that deaf youth can set goals aligned with their strengths and interests, work toward those goals, and advocate for themselves. Although it is important to understand the development of self-determination among deaf youth by looking at individual-level factors, we must also examine environmental factors that can impede, or enhance, opportunities for developing self-determination for deaf youth.

## Measuring Self-Determination

Critical to efforts to promote the development of self-determination during the transition from school to adult life is ensuring that there are assessments that can be used to understand adolescents' self-determination and that these assessments have sufficient validity and reliability evidence to support this use. The *Self-Determination Inventory: Student Report* (SDI:SR) (Shogren et al., 2017) was developed to meet the need for a self-report measure of self-determination to inform instructional planning and outcome assessment. The *SDI:SR* was developed to align with Causal Agency Theory (Shogren, Wehmeyer, Palmer, Forber-Pratt, et al., 2015), a theory to conceptualize the development of self-determination in adolescents with and without disabilities. Causal Agency Theory integrates past theoretical work and research on the development of self-determination in the fields of education and psychology and defines self-determination as a "dispositional characteristic manifested as acting as the causal agent in one's life" (Shogren, Wehmeyer, Palmer, Forber-Pratt, et al., 2015, p. 258). Causal Agency Theory identifies three essential characteristics of self-determined actions: volitional action, agentic action, and action control beliefs. *Volitional action* refers to the extent to which a person makes intentional, conscious choices based on preferences and self-initiates goal setting using past experiences as a guide. *Agentic action* involves self-directing and managing actions toward a freely chosen goal, including identifying different pathways to navigate around barriers encountered when pursuing goals. Finally, *action-control beliefs* relate to recognizing one's own strengths and needs related to goal pursuits and feeling empowered to engage in goal-directed actions.

The SDI:SR was originally developed in American English and validated with over 4,000 adolescents with and without disabilities (Shogren et al., 2020). Shogren et al. (2018a) provided additional data on differences in scores based on disability status and label and race/ethnicity, suggesting the tool is sensitive to differences across subpopulations as hypothesized. Researchers have argued that there are universal elements of the self-determination construct, although also acknowledged that self-determined actions may be expressed differently across cultures and languages (Shogren, 2011). The SDI:SR has been translated into multiple languages (e.g., Spanish, French, Chinese), and researchers found evidence of similar psychometric properties of translated versions (Lachapelle et al., 2021; Mumbardó-Adam, Guàrdia-Olmos, Giné, Raley, & Shogren, 2017; Xu, Qian, Rifenbark, & Shogren, in press). Furthermore, researchers have found that the same factor structure is observed across the SDI:SR and the SDI:SR Spanish Translation in youth with and without disabilities in the United States and Spain (Shogren, Shaw, & Mumbardó-Adam, 2019).

## Measure Development and Translation for Deaf Populations

Measure development, translation, and interpretation that involve deaf people must consider a multitude of factors including test format, student characteristics, and target content area (Cawthon et al., 2009; Henner, Novogrodsky, Reis, & Hoffmeister, 2018). Measures that are delivered via written English and built based on the cultural practices and norms of nondeaf people, may have construct irrelevant variance when used with deaf people (Cawthon et al., 2009). Translation of written English items into American Sign Language (ASL) is a possible solution to this access issue. Research providing evidence of the feasibility and usability of embedding ASL translations of English items within test delivery systems was conducted more than a decade ago (Russell, Kavanaugh, Masters, Higgins, & Hoffmann, 2009) and continues to be explored (Hansen et al., 2018; Higgins et al., 2016; Kushalnagar, Harris, Paludneviciene, & Hoglind, 2017). Current research identifies two important practices in English to ASL translation.

First, use a team-based approach that includes a balance of expertise in the content area of the assessment and deaf ASL translation experts (Kushalnagar et al., 2017, Kushalnagar, Paludneviciene, Kallen, Atcherson, & Cella, 2020, Measured Progress Innovation Lab, 2014). Including perspectives of the target population is a recommended practice to adequately respond to questions of construct equivalence across cultures

(Oakland, 2009). For example, multicultural testing translations often involve modifications or adaptations including leaving out specific items that are deemed culturally irrelevant or biased, repeating or simplifying instructions, and administering tests without time constraints (Ortiz et al., 2012). Translating items from English to ASL is not an exercise in direct word translation and requires balancing content and linguistic perspectives to arrive at an ASL item that is accessible to a diverse deaf population.

Second, use a multistep process of discussing the translation, drafting videos, obtaining input using strategies like back translation, and final filming (Higgins et al., 2016; Kushalnagar et al., 2017; Kushalnagar, Paludneviciene, et al., 2020). This process allows for using evidence to maintain the meaning of the items, as intended by the assessment developers, in a linguistically and culturally appropriate way. This is similar to a community-participatory approach to research and evidence building, a practice that has already been emphasized as a strategy to minimize testing bias for deaf individuals (Graybill et al., 2010; Roberts et al., 2015). As both members of the deaf community and trained interpreters, Certified Deaf Interpreters (CDIs) are in a unique position to add to the validity of a translation process (Boudreault, 2005). CDIs also bring an emic perspective to translation work, with their lived experience of being deaf. These emic perspectives lead to greater likelihood of cultural relevance of the translation, acceptance of the translation by the deaf community, and a stronger understanding of where and how miscommunication may occur in translation.

## Purpose

This paper describes the development, initial validation, and an application of the SDI:SR ASL Translation (SDI:SR ASL). As part of the initial validation of the SDI:SR ASL, we explored its psychometric characteristics and compared them to psychometric characteristics of the original SDI:SR administered in American English to students with and without disabilities. We next used the scores to examine differences across deaf students who took the SDI:SR ASL and hearing students with and without disabilities who took the SDI:SR.

The primary focus of this initial validation process was on exploring the extent to which the proposed interpretations and uses of the SDI:SR ASL, a measure of self-determination in deaf youth, are supported. We adopted the argument-based approach as a framework for validation (AERA, APA, & NCME, 2014; Kane, 2013, 2015). This approach involves specifying claims that need to be supported to justify the proposed interpretations and uses of the assessment, then evaluating these claims through theoretical or empirical evidence. In this study, our validation efforts focused on claims about the basic psychometric quality of the assessment: item characteristics, internal structure, internal consistency, and measurement invariance. As shown in Table 1, we first (Part 1) examined claims using data collected with deaf youth who completed the SDI:SR ASL (referred hereafter as the deaf group). Next, we explored data from the deaf group as well as data from additional hearing participants with and without disabilities who completed the SDI:SR in American English (referred hereafter as the Disability and No Disability groups, respectively; Part 2). Finally, beyond validation, we explored potential differences in scores across the three groups (Part 3). All claims, research questions, and analytic techniques are presented in Table 1. Examining the extent to which aspects of validity, targeted in this study, are supported by evidence is essential to guide ongoing work advancing the use of the SDI:SR ASL in research and practice. However, future examination of additional claims will be needed to fully justify the proposed interpretations and uses of the SDI:SR ASL with deaf youth.

## Method

### Sample

The sample for this study was a nonrandom sample of 3,309 young people who completed either the SDI:SR ASL (the deaf group; $n = 392$), the SDI:SR and self-reported having a disability (the Disability group; $n = 286$), and the SDI:SR and self-reported not having a disability (the No Disability group; $n = 2{,}631$) online. The SDI:SR and SDI:SR ASL are completed online via the www.self-determination.org website as well as through a fee-based data management system used by school districts and research teams across the United States. The nonrandom sample was generated from data collected through both of these sources, consistent with approved IRB protocols. The nonrandom sample of participants who completed the SDI:SR was engaged in research studies or participating in self-determination interventions in their schools with the SDI:SR used to track outcomes. Only the first record for any participant was used in these cases. Participants in the SDI:SR ASL sample were recruited through strategic communication and dissemination activities intended to reach professionals working with deaf students throughout the U.S. (e.g., transition specialists, vocational rehabilitation professionals, and high school administrators). Although the sample was not designed to be representative, broad outreach occurred to ensure a sufficient sample in the deaf group.

To be included in the sample, participants had to live in the U.S., be between the ages of 13–22 (the ages for which the SDI:SR were originally validated; Shogren et al., 2020), and have completed the SDI:SR or SDI:SR ASL. Participants also had to have no more than three missing items on the SDI:SR or SDI:SR ASL (88.29% of the original sample of 3,748 respondents who answered at least one SDI:SR item) to be included in the sample. By restricting our sample to this subset, we aimed to enhance the

**Table 1.** Validation and research plan

| Claim/RQ # | Claim | Research Question | Methods |
|---|---|---|---|
| Part 1: Validating SDI:SR ASL | | | |
| 1.1 | Observed characteristics of item scores on the SDI:SR ASL are consistent with expected characteristics. | What are the characteristics of item scores in the SDI:SR ASL? | Descriptive statistics, frequencies, bivariate correlations |
| 1.2 | The SDI:SR ASL has an established internal structure. | What is the internal structure of the SDI:SR ASL? | A series of confirmatory factor analyses (CFAs) |
| 1.3 | Scores on the SDI:SR ASL are internally consistent. | What is the internal consistency of scores on the SDI:SR ASL? | Omega total |
| Part 2: Validating SDI:SR ASL in comparison to SDI:SR Disability and SDI:SR No Disability | | | |
| 2.1 | The SDI:SR ASL functions in the same way as the SDI:SR for participants with and without disabilities. | Is measurement invariance of the SDI:SR supported for participants who completed the SDI:SR ASL and for participants with and without disabilities who completed the SDI:SR? | A series of multigroup CFAs; the alignment method |
| Part 3: Exploration | | | |
| 3.1 | N/A | Are there latent mean and variance differences in self-determination between participants who completed the SDI:SR ASL and participants with and without disabilities who completed the SDI:SR? | A series of multigroup CFAs; the alignment method |

quality of data. We also took steps to mitigate the risk of accidentally including data in the analysis potentially generated from online users only exploring the system for training or planning purposes rather than seriously attempting to take the instrument. For example, during training or information sessions on the SDI:SR, users are instructed to enter "test" for their name, if they are only exploring the system during training. All data were screened and when "test" was used, these cases were removed. To be included in the Disability group, participants had to have taken the SDI:SR in American English and reported having a disability other than hearing loss or deafness. Finally, participants in the No Disability group had to take the SDI:SR in American English and report not having a disability. To be included in the deaf group, participants had to have taken the SDI:SR ASL version and also have reported having hearing loss or deafness as a primary or secondary disability and/or self-identified (on a separate question) as being hard of hearing, deaf, deafblind, late deafened, or culturally deaf.

Tables 2 and 3 provide demographic information for the three groups. The presented demographic information is based on self-reported data. Additional demographic items are asked after completion of the SDI:SR ASL to better understand specific demographic characteristics of deaf participants (e.g., deaf identity, educational background, presence of deaf members in their family, communication strategies across a range of contexts, communication modalities, and languages used). The overall age across samples averaged 15.30 (SD = 1.44); in the deaf group, participants were slightly older, on average, 16.41 (SD = 2.45), followed by the Disability 15.84 (SD = 1.71) and No Disability 15.07 (SD = 1.07) groups. The three samples were roughly divided between identifying as male or female, although there were slightly more males in the disability group. Approximately 50% or more of each sample identified as white. Approximately 8% of the SDI:SR ASL group, 18% of the SDI:SR Disability group, and 26% of the SDI:SR No Disability group identified as African American/Black, and 14% (SDI:SR No Disability), 20% (SDI:SR Disability), and 24% (SDI:SR ASL) sample identified as Hispanic or Latinx. In the Disability group, multiple primary and secondary disability labels were noted (participants could select multiple secondary disabilities), with the largest groups being those with intellectual disability, learning disability, and other health impairments. In the deaf group, as expected, hearing loss or deafness was the most commonly identified primary or secondary disability. In total, 328 (84%) participants in the deaf group identified deafness or hearing loss as a primary (73%) or secondary (11%) disability; 16% did not identify deafness or hearing loss as a primary or secondary disability but did indicate identifying as deaf or hard of hearing in a separate question about identity.

Approximately 19.4% of students in the deaf group reported not attending school at the time of data collection, with the remaining attending general public education (36.7%), a deaf program in public school (22.2%), and/or a deaf school (19.1%). Participants could select more than one type of school. Although a majority of respondents reported not having any deaf family members (64.3%), there was a larger than anticipated number of respondents who have deaf family members (29.3%), most of whom lived with the respondents. In terms of communication, respondents could select multiple options for how they communicated at school

**Table 2.** Characteristics of the sample

| Characteristic | SDI:SR ASL (N = 392) | | SRI:SR disability (N = 286) | | SDI:SR no disability (N = 2,631) | |
|---|---|---|---|---|---|---|
| | n | % | n | % | n | % |
| Gender | | | | | | |
| Male | 183 | 46.68 | 162 | 56.64 | 1,261 | 47.93 |
| Female | 191 | 48.72 | 108 | 37.76 | 1,300 | 49.41 |
| Nonbinary | 7 | 1.79 | 3 | 1.05 | 12 | 0.46 |
| Preferred to self-describe | 0 | 0.00 | 1 | 0.35 | 11 | 0.42 |
| Preferred not to say | 5 | 1.28 | 8 | 2.80 | 8 | 0.30 |
| Not specified | 6 | 1.53 | 4 | 1.40 | 39 | 1.48 |
| Race | | | | | | |
| American Indian or Alaska Native | 9 | 2.30 | 7 | 2.45 | 46 | 1.75 |
| African American/Black | 31 | 7.91 | 51 | 17.83 | 694 | 26.38 |
| Native Hawaiian or Pacific Islander | 7 | 1.79 | 0 | 0.00 | 8 | 0.30 |
| White/Caucasian | 224 | 57.14 | 159 | 55.59 | 1,300 | 49.41 |
| Asian (i.e., Korean, Japanese, Southeast Asia, Indian subcontinent) | 25 | 6.38 | 5 | 1.75 | 112 | 4.26 |
| Two or more races | 18 | 4.59 | 18 | 6.29 | 171 | 6.50 |
| Other | 29 | 7.40 | 15 | 5.24 | 125 | 4.75 |
| Not specified | 49 | 12.50 | 31 | 10.84 | 175 | 6.65 |
| Hispanic or Latino/a | | | | | | |
| No | 294 | 75.00 | 215 | 75.17 | 2,197 | 83.50 |
| Yes | 95 | 24.23 | 57 | 19.93 | 369 | 14.03 |
| Not specified | 3 | 0.77 | 14 | 4.90 | 65 | 2.47 |
| Disability status | | | | | | |
| No disability | 55 | 14.03 | 0 | 0.00 | 2,631 | 100.00 |
| Disability | 336 | 85.71 | 286 | 100.00 | 0 | 0.00 |
| Disability status unknown | 1 | 0.26 | 0 | 0.00 | 0 | 0.00 |
| Primary Disability | | | | | | |
| Learning disability | 4 | 1.02 | 48 | 16.78 | | |
| Intellectual disability | 3 | 0.77 | 61 | 21.33 | | |
| Speech/language disability | 1 | 0.26 | 3 | 1.05 | | |
| Autism spectrum disorder | 3 | 0.77 | 39 | 13.64 | | |
| Hearing loss or deafness | 285 | 72.70 | 0 | 0.00 | | |
| Vision loss or blindness | 3 | 0.77 | 8 | 2.80 | | |
| Physical disability | 2 | 0.51 | 7 | 2.45 | | |
| Emotional or behavioral disturbance | 0 | 0.00 | 12 | 4.20 | | |
| Other health impairment (e.g., ADHD, asthma) | 8 | 2.04 | 47 | 16.43 | | |
| Traumatic brain injury (TBI) | 0 | 0.00 | 3 | 1.05 | | |
| Multiple disabilities | 26 | 6.63 | 25 | 8.74 | | |
| Other | 1 | 0.26 | 1 | 0.35 | | |
| Not specified | 0 | 0.00 | 32 | 11.19 | | |
| Secondary disability[a] | | | | | | |
| Learning disability | 30 | 7.65 | 24 | 8.39 | | |
| Intellectual disability | 7 | 1.79 | 12 | 4.20 | | |
| Speech/language disability | 38 | 9.69 | 32 | 11.19 | | |
| Autism spectrum disorder | 8 | 2.04 | 8 | 2.80 | | |
| Hearing loss or deafness | 43 | 1.97 | 0 | 0.00 | | |
| Vision loss or blindness | 30 | 7.65 | 13 | 4.55 | | |
| Physical disability | 19 | 4.85 | 13 | 4.55 | | |
| Emotional or behavioral disturbance | 20 | 5.10 | 25 | 8.74 | | |
| Other health impairment (e.g., ADHD, asthma) | 48 | 12.24 | 24 | 8.39 | | |
| Traumatic brain injury (TBI) | 1 | 0.26 | 2 | 0.70 | | |
| Multiple disabilities | 2 | 0.51 | 7 | 2.45 | | |
| Other | 4 | 1.02 | 4 | 1.40 | | |
| Not specified | 117 | 29.85 | 152 | 53.15 | | |
| No secondary disability | 76 | 19.39 | 32 | 11.19 | | |
| Language other than English spoken at home | | | | | | |
| No | | | 219 | 76.57 | 2082 | 79.13 |
| Yes | | | 50 | 17.48 | 425 | 16.15 |
| Not specified | | | 17 | 5.94 | 124 | 4.71 |
| Identify as a ___ person[a] | | | | | | |
| Hearing | 24 | 6.12 | | | | |

*(Continued)*

**Table 2.** Continued

| Characteristic | SDI:SR ASL (N = 392) | | SRI:SR disability (N = 286) | | SDI:SR no disability (N = 2,631) | |
|---|---|---|---|---|---|---|
| | *n* | % | *n* | % | *n* | % |
| Hard of hearing | 208 | 53.06 | | | | |
| Deaf | 183 | 46.68 | | | | |
| Deafblind | 8 | 2.04 | | | | |
| Late deafened | 5 | 1.28 | | | | |
| Culturally deaf | 16 | 4.08 | | | | |
| Other | 11 | 2.81 | | | | |
| Not specified | 26 | 6.63 | | | | |
| Type of school[a] | | | | | | |
| School only for deaf students | 75 | 19.13 | | | | |
| Deaf program in public school | 87 | 22.19 | | | | |
| General public education with hearing students | 144 | 36.73 | | | | |
| Private school with hearing students | 18 | 4.59 | | | | |
| Other | 25 | 6.38 | | | | |
| In school but type of school not specified | 20 | 5.10 | | | | |
| Having deaf family members | | | | | | |
| Yes, and I live with deaf family members | 77 | 19.64 | | | | |
| Yes, and I do not live with deaf family members | 38 | 9.69 | | | | |
| No | 252 | 64.29 | | | | |
| Not specified | 25 | 6.38 | | | | |
| Communication with others at school or work[a] | | | | | | |
| Direct through sign language or spoken language | 324 | 82.65 | | | | |
| Use an interpreter | 117 | 29.85 | | | | |
| Speech-to-text app or CART | 23 | 5.87 | | | | |
| Write or text | 128 | 32.65 | | | | |
| Do not frequently communicate often | 24 | 6.12 | | | | |
| Other | 10 | 2.55 | | | | |
| Not specified | 27 | 6.89 | | | | |
| Communication with others during extracurricular activities (e.g., outside of the classroom, workplace, or training program)[a] | | | | | | |
| Direct through sign language or spoken language | 319 | 81.38 | | | | |
| Use an interpreter | 73 | 18.62 | | | | |
| Speech-to-text app or CART | 10 | 2.55 | | | | |
| Write or text | 122 | 31.12 | | | | |
| Do not frequently communicate often | 32 | 8.16 | | | | |
| Other | 8 | 2.04 | | | | |
| Not specified | 29 | 7.40 | | | | |

*Note.* For primary and secondary disabilities, frequencies for participants without disabilities and with an unknown disability status are omitted. [a]The total does not equal to the number of participants in a subgroup (or 100%) because participants could select multiple response options.

**Table 3.** Descriptive statistics for modes of communication in the SDI:SR ASL group

| Modes of communication | Total N[a] | No use of the language | | Language proficiency[b] | | |
|---|---|---|---|---|---|---|
| | | N | % | N | Mean | SD |
| American Sign Language | 356 | 83 | 23.31 | 273 | 3.08 | 1.52 |
| Cued speech | 348 | 280 | 8.46 | 68 | 2.65 | 1.50 |
| Signed exact English | 349 | 200 | 57.31 | 149 | 2.71 | 1.41 |
| English (oral) | 296 | 56 | 18.92 | 240 | 3.98 | 1.36 |
| English (written) | 296 | 11 | 3.72 | 285 | 3.83 | 1.35 |
| Spanish (oral) | 353 | 244 | 69.12 | 109 | 2.05 | 1.38 |
| Spanish (written) | 357 | 262 | 73.39 | 95 | 1.89 | 1.21 |

*Note.* [a] Total number of participants who reported the information about modes of communication. Participants had an opportunity to report on each on these modes. [b] Language proficiency of those participants who use the language; measured on the 5-point scale: 1 = Beginner, 2 = Intermediate, 3 = Proficient, 4 = Fluent, 5 = Native.

or work or during extracurricular activities. The majority of the deaf group reported directly communicating with others via signed or spoken languages at school or work (82.7%) or during extracurricular activities (81.4%). Other methods of communication that deaf respondents used at school or work were writing or texting (32.7%), interpreters (29.9%), and/or speech to text services (5.9%). A smaller subset of participants reported not communicating often at school or work (6.1%) or during extracurricular activities (8.2%). Modes of communication and languages used by the participants, and their self-rated proficiency levels (on a scale from 1–5), varied extensively. Participants had an opportunity to report on each of the modes and languages. Out of the participants who provided this information, 76.7% reported using ASL, with mean proficiency of 3.08 (SD = 1.52), 96.3% reported using written English, with a mean proficiency of 3.83 (SD = 1.35), and 81.1% reported using spoken English, with mean proficiency of 3.98 (SD = 1.36). Smaller percentages of participants, also out of those who provided this information, used cued speech (19.5%), Signed Exact English (42.7%), and written or spoken Spanish (26.6% or 3.9%, respectively). In the SDI:SR Disability and SDI:SR No Disability groups, ∼17% and 16% of participants, respectively, reported using languages other than English at home.

## Measures

### *SDI:SR*

The SDI:SR is a self-report measure that contains 21 items that align with Causal Agency Theory (Shogren, Wehmeyer, Palmer, Forber-Pratt, et al., 2015). The SDI:SR is administered online and responses to each of the items are indicated on a slider (or visual analogue) scale that is scored by the computer on a range from 0 to 99 (or disagree to agree) (Shogren et al., 2020). Researchers have found that the slider scale and computer scoring allow for sensitivity and specificity of response (Raley, Shogren, Rifenbark, Anderson, & Shaw, 2019). The online version of the tool also offers other accessibility features such as in-text definitions, video or audio playback. Validity and reliability evidence was provided for the use of the SDI:SR with adolescents with and without disabilities in the United States, aged 13–22 (Shogren et al., 2020; Shogren, Shaw, Raley, & Wehmeyer, 2018b).

### *SDI:SR ASL translation*

The 21 items included in the SDI:SR were translated from English to ASL following established protocols. The goal of translating SDI:SR items from English to ASL is to be able to measure self-determination skills of deaf students who use ASL. Maintaining the meaning of the English item does not entail a literal or direct word for word translation of the item, but rather a linguistically and culturally accurate translation (Kushalnagar et al., 2017). The 21 items included in the SDI:SR, along with the demographic items, were translated using the frameworks of both international translation guidelines (International Test Commission [ITC], 2017) and established protocols for English to ASL survey translation (Kushalnagar et al., 2017; Kushalnagar, Paludneviciene, et al., 2020). Key elements of both processes include using an iterative, team-based approach with experts who have deep cultural and linguistic understanding of the target translation language.

The SDI:SR English to ASL translation process focused on two steps described in the ITC standards: Precondition and Test Development (ITC, 2017). Precondition refers to tasks that must be completed before translation can begin. As part of this step, intellectual property permission was granted from the University of Kansas to translate the SDI:SR content to ASL. Next the self-determination constructs were coexamined at an item level by a CDI and a deaf educational psychologist, both native signers with extensive training in their respective fields. The CDI then worked independently with another CDI with expertise in ASL translation to forward translate and document how to represent each English item in ASL in a culturally and linguistically accurate way. Initial test item translations were prepared for filming after a review by the deaf educational psychologist and construct-relevant adjustments were made.

The Test Development step consisted of creating ASL items that accounted for linguistic, psychological and cultural differences between the SDI:SR items in English and ASL and collecting validity evidence. The creation of ASL items involved an on-site filming team of the signer who was the same CDI described above, the deaf educational psychologist who served as the on-site filming consultant and ASL coach, and a deaf videographer. Although the CDI signed each item for filming, the deaf educational psychologist observed and consulted with the CDI to provide input on item content, meaning, and ASL characteristics such as nonmanual markers and prosody. The deaf videographer, with expertise in important visual representation factors such as lighting and space, also provided in situ feedback.

The validation steps consisted of back translation of the ASL items, and cognitive labs (Willis, 2004) with deaf youth, who provided input on the intent and clarity of each item. The back translation process involved asking an external reviewer, who was a deaf native signer and a doctoral student in psychology, to view ASL videos and back translate these videos to English text based on their perception of the item.

The cognitive debriefing process was modeled on the work of the Center for Deaf Health Equity (Kushalnagar, Paludneviciene, et al., 2020). Cognitive labs consisted of two waves of in-person focus group sessions with young deaf adult ASL signers, between the ages of 18–19. The first wave, with two participants, focused on reviewing the response scale and the first 10 items of the measure and the second focus group, with three participants, reviewed the remaining 11 items. Following reviews of each ASL version of the response scale instructions and items, participants were asked to describe what they believe the item is inquiring about, how they would respond to the item, and whether there were different ways to answer the item. After noting what they thought the ASL item was asking them, they were shown the English text version of the item to qualitatively evaluate item equivalence across languages and elicit further feedback on how the ASL version could be improved. Overall feedback on the appropriateness of body language, facial expressions, and pacing as well as general suggestions to improve ASL items were also elicited from the participants. This process has been documented to strengthen the validity of the items in ASL (Kushalnagar, Paludneviciene, et al., 2020). Based on these two validation activities, the lead deaf educational psychologist made decisions on which items should be refilmed and what needed to change in the ASL item. Of the 21 items, 7 (33%) were refilmed.

After filming was completed, the next step was to use the videos to create the online SDI:SR ASL administration platform on the self-determination.org website. For the SDI:SR ASL, each item was presented on a screen with the ASL video, the English text of the item and the slider scale used for the SDI:SR. Each ASL video was presented on the top of the screen and played automatically when users navigated to the page, with English text immediately underneath. Response options were available in ASL video which users could click to view. Users completed a practice item before the SDI:SR ASL items with instructions and opportunities to practice the rating scale and format. At the end, users receive a report providing immediate feedback on their self-determination scores. An ASL video was also developed to introduce the score report.

## Data Analysis

In the following sections, we highlight how data were examined to engage in the validation activities described in Table 1. We first describe how missing data were handled in the analyses, the approach taken to addressing each research question (see Table 1), as well as any pre-processing of data that occurred to address each question. Overall, the analytic methods included descriptive statistics, frequencies, and correlations to examine item characteristics, a series of confirmatory factor analyses (CFAs) to explore the internal structure of the SDI:SR ASL, omega total to determine internal consistency of scores on the SDI:SR ASL, as well as a series of multigroup CFAs and the alignment method to investigate measurement invariance across the deaf, Disability, and No Disability groups and to explore mean and variance differences across these groups.

Data, syntax, and outputs for the conducted analyses are available on the Center for Open Science (OSF) website at https://osf.io/g5mc6/.

### *Missing data*

The number of available responses and the number of missing responses for each item in each group are presented in Supplementary Table 1. There were between one and three missing item response for 20% of participants in the SDI:SR ASL group (79 out of 392 participants), 9% of participants in the SDI:SR Disability group (27 out of 286 participants), and 9% of participants in the SDI:SR No Disability group (233 out of 2,631 participants). In the latent variable analyses, item-level missing data were handled via a full information maximum likelihood (FIML) approach. FIML is a recommended technique for handling missing data (Schafer & Graham, 2002). The advantage of this technique is that it is embedded into the estimation process and uses all available item-level responses from a person—even if some items were missing—to estimate model parameters (Enders & Baraldi, 2018). All latent variable models were estimated in Mplus, version 8.6 (Muthén & Muthén, 2019).

### *Part 1: SDI:SR ASL*

#### Research Question 1.1

To evaluate the characteristics of the items on the SDI:SR ASL, we examined item descriptive statistics, frequencies, and bivariate correlations, obtained via SAS, version 9.4 (SAS/STAT 14.1 User's Guide, 2015). Items of good quality should be approximately normally distributed. Furthermore, item correlations should be moderate-to-high for the items to be reliable measures of a common factor (Bollen & Lennox, 1991).

#### Research Question 1.2

To examine the internal structure of the SDI:SR ASL, we conducted a series of CFAs. In particular, we investigated two possible internal structures. First was the three-dimensional structure based on the original theoretical structure of self-determination used to develop the SDI:SR. In this structure, items were grouped by the three essential characteristics (Shogren, Wehmeyer, Palmer, Forber-Pratt, et al., 2015). Second was the unidimensional structure based on the prior SDI:SR research with a single general self-determination factor (Shogren, Shaw, Raley, & Wehmeyer, 2018a). To estimate CFA models, we used the robust Maximum Likelihood (MLR) estimator because of its ability to produce standard errors and a Chi-square test statistic that are robust to nonnormality. For model fit evaluation, we examined the following indicators of global fit: the Satorra-Bentler Scaled Chi-square test of exact fit and approximate global fit indices, specifically the Root Mean Square Error of Approximation (RMSEA) with a 90% confidence interval, the Standardized Root Mean Square Residual (SRMR), the Bentler Comparative Fit Index (CFI), and the Tucker Lewis Index (TLI). Model fit is considered excellent if the Chi-square test produces a statistically nonsignificant result. Furthermore, RMSEA <.06, SRMR <.08, and CFI and TLI above .95 may suggest good model fit (Hu & Bentler, 1999).

Given that global indicators of model fit are not capable of determining the size and distribution of misfit in the model, we also evaluated local misfit via an investigation of statistically significant modification indices (MIs; $p < .05$; MI greater than 3.84) and associated expected standardized parameter changes. Identifying and addressing sources of substantial local misfit (e.g., omitted errors correlations) are critical because they may lead to substantially distorted parameter estimates (Bocell, 2015). To determine if the misfit was small enough to be considered ignorable, we conducted a sensitivity check (Byrne, Shavelson, & Muthén, 1989). We took an iterative approach in which the largest MI was used to free a single error correlation, and then the next iteration repeated this step. This process was conducted until a well-fitting model was found using the overall Chi-square test of model fit ($p > .05$). Then, we compared standardized loadings between the original model with no error correlations and the well-fitting model. Using subjective judgement, we evaluated the magnitude of these differences to determine if they were substantial, or if they were small enough as to be inconsequential to model interpretation. If the differences were found to be large, we planned to identify and address the sources of the largest differences.

Next, in addition to an evaluation of model fit, we examined the significance and size of standardized factor loadings. Standardized loadings may be considered salient if they are at least .3 (Brown, 2015). However, we also considered removing items with significant standardized loadings above .3 when such loadings were low relative to standardized loadings of other items. Finally, to select a model out of multiple competing nested models, we compared the fit of these models via the Chi-square difference testing appropriate for the MLR estimator (*Mplus*, n.d.).

#### Research Question 1.3

To determine the internal consistency of the SDI:SR ASL, we computed omega total. Omega total was selected instead of more conventional Cronbach's alpha because omega total does not require the model to be essentially tau-equivalent, i.e., to have equal loadings (e.g., McNeish, 2018). To evaluate the value of omega total, we employed the convention for evaluating Cronbach's alpha. In particular, Cronbach's alpha above .7 may be considered as an indicator of good internal consistency (Nunnally & Bernstein, 1994). We computed omega total in Mplus, version 8.6 (Muthén & Muthén, 2019), using the model accepted as the internal structure of the SDI:SR ASL.

### *Part 2: SDI:SR ASL and SDI:SR*

#### Preprocessing

Two steps were taken before beginning analyses for Part 2. First, we examined item characteristics across the SDI:SR ASL, SDI:SR Disability, and SDI:SR No Disability groups. The analysis involved the same techniques described in Research Question 1.1 but were applied across the three groups. Second, we tested if the model accepted as the internal structure of the SDI:SR ASL held for the sample that included not only the SDI:SR ASL group but also the SDI:SR Disability and SDI:SR No Disability groups. An evaluation of model fit included the same procedures that were specified for Research Question 1.2.

#### Research Question 2.1

To determine if measurement invariance was supported across the SDI:SR ASL, SDI:SR disability, and SDI:SR no disability groups for the model accepted as the internal structure of the SDI:SR ASL, we conducted a series of multigroup CFAs. The SDI:SR no disability group was used as the reference group. The measurement invariance testing involved three successive steps: testing for configural invariance (i.e., determining if the SDI:SR ASL internal structure applies to all groups), metric invariance (i.e., determining if the construct is manifested in the same way across the three groups), and scalar invariance (i.e., determining if the response scale is used in the same way across the three groups).

In testing for configural invariance, we specified the same factor structure across the groups, allowed for loadings and intercepts to be freely estimated, and fixed factor means and variances in each group to zero and one, respectively. Next, testing for metric invariance, we constrained loadings to be equal across groups, allowed intercepts to be freely estimated in each group, fixed factor means to zero in each group, fixed factor variance in the reference group to one, and allowed factor variances in other groups to be freely estimated. Finally, testing for scalar invariance, we constrained loadings and intercepts to be equal across groups, fixed the factor mean and variance in the reference group to zero and one, respectively, and allowed factor means and variances in other groups to be freely estimated. To evaluate model fit, test sensitivity of adding error correlations in the configural model, and to compare fit across models, we used the same procedures that were specified for Research Question 1.2.

If scalar invariance is not supported, the alignment method is useful for identifying noninvariant loadings and intercepts (Asparouhov & Muthén, 2014). This method identifies the most optimal pattern of measurement invariance. For each item, it produces a set of groups, for which approximate invariance of loadings (or intercepts) holds; items not in the set have loadings (or intercepts) that differ from the mean loading (or intercept) of the set. The alignment model has the fit of the configural model.

### *Part 3: Latent differences across SDI:SR ASL, SDI:SR disability, SDI:SR no disability*

#### Research Question 3.1

If scalar invariance was supported, we planned to proceed to explore group differences in factor means and variances via another series of multigroup CFAs. Specifically, we planned to test models with factor mean or variance equality constraints placed in the scalar invariance model. To evaluate model fit and compare it across models, we again planned to use the same procedures that were specified for Research Question 1.2. First, we planned to test the models with equal factor means (or variances) across all groups by fixing them to zero (or one). Statistically significantly worse fit of these models in comparison to the fit of the scalar invariance model would suggest the presence of differences between at least some groups. In this case, follow-up testing of models with pairwise constraints of factor means (or variances) being equal across groups would be warranted. Here, factor means (or variances) of the two groups under investigation were fixed at zero (or one), whereas the factor mean (or variance) of the third group was freely estimated. The statistically significantly worse fit of these models in comparison to the fit of the scalar invariance model would identify which groups differ in factor means (or variances). To conduct these comparisons, we applied the Bonferroni correction, adjusting the alpha level to .05/3 = .017. Estimates of factor means (or variances) were obtained from the scalar invariance model.

If scalar invariance was not supported, we planned to implement the alignment method, as it allows researchers to estimate group-specific factor means and variances in the absence of scalar invariance. The alignment output in Mplus also produces a report of statistically significant factor mean differences. If scalar invariance was accepted only tentatively, we planned to employ the alignment method as a sensitivity check.

# Results

## Part 1: SDI:SR ASL

In part 1, we report the results for the analyses on the SDI:SR ASL group. Specifically, we evaluated validity evidence for item characteristics (RQ 1.1), internal structure (RQ 1.2), and internal consistency (RQ 1.3) of the SDI:SR ASL.

### *Research question 1.1*

Item descriptive statistics for the SDI:SR ASL group are presented in Supplementary Table 1. The results show that the items are negatively skewed. Furthermore, two items—Q2 ("I choose activities I want to do") and Q20 ("I work hard to reach my goals")—had sharper peaks than other items. An examination of frequencies indicated that the highest response option was selected substantially more commonly than other response options (see Figure 1 for an example item distribution). Across all items, the average percentage of participants selecting the highest response option was 25.23% (SD = 4.25), with a maximum of 35.84% for Q20. Finally, item correlations were, on average, .415 (SD = .091), ranging from .160 to .657. Considering only correlations of the items that were designed to indicate each of the three essential characteristics, the mean was .437 (SD = .087), ranging from .260 to .657.

Overall, the results indicated some deviations from the expected item characteristics. Specifically, item distributions deviated from normality, the frequency of selecting the highest response option was substantially larger than other options, and some item correlations were lower than desired. However, these deviations were not extreme. Thus, the results for Research Question 1.1 provided some evidence for the claim that observed characteristics of item scores on the SDI:SR ASL are as expected.

### *Research question 1.2*

Consistent with previous research with the SDI:SR, the three-factor model was tested but rejected because it produced very high factor correlations, ranging from .930 to .977. The fit of the unidimensional model was as follows: Chi-square (189) = 4.179, $p < .0001$, RMSEA = .053, 90% CI [.046, .061], SRMR = .049, CFI = .909, and TLI = .899, whereas RMSEA and SRMR were within the acceptable range, the Chi-square test, CFI, and TLI suggested poor fit. An examination of MIs revealed that, amongst the significant MIs, one MI was substantially larger than others, suggesting an error correlation of .435 between Q16 ("I know what I do best") and Q18 ("I know my strengths"). The next largest MI suggested an error correlation of .270 between Q17 ("I am confident in my abilities") and Q18. Thus, it seemed that Q18 shared something with Q17 and Q16 above and beyond what was explained by the one-factor model, presenting a violation of local independence. Thus, we removed Q18. As Q18 had similar content to Q16 and Q17, we did not feel that removing this item would lead to construct underrepresentation.

After removing Q18, the 20-item unidimensional model was tested. The fit of this model was as follows: Chi-square (170) = 316.326, $p < .0001$, RMSEA = .047, 90% CI [.039, .055], SRMR = .046, CFI = .930, and TLI = .922. Similar to the 21-item model, RMSEA and SRMR were within the acceptable range, whereas the Chi-square test, CFI, and TLI suggested poor fit. However, no MIs substantially larger than others were detected. The largest MI suggested an expected error correlation of .256 between Q16 and Q17. To examine if these MIs were substantial enough for the ignored misfit to lead to distorted estimates of standardized loadings, we conducted a sensitivity check. Specifically, we compared standardized loadings of our unmodified model against those of a well-fitting model with 16 error correlations, Chi-square (154) = 183.865, $p = .051$. The absolute value of differences in standardized loadings was, on average, .008 (SD = .009), with a maximum of .036. We considered this difference to be trivial and, hence, inconsequential for model interpretation. Thus, as some fit indices were within the acceptable range and as the impact of misfit on loading estimates due to omitted error correlations was low, we treated the fit of the unmodified 20-item model as acceptable. Next, we investigated standardized loadings in this model and found that the standardized loading for Q3 ("I choose what my room looks like") was lower than others. Specifically, it was .425, whereas the second lowest standardized loading was .532 for Q10 ("I think of more than one way to solve a problem"). Q3 is more context-specific than other items (i.e., asks about a respondent's room), which may explain why its relationship with the latent variable is weaker. Furthermore, this item has been found to have low standardized loadings in validation studies of other translated versions of the SDI:SR (Lachapelle et al., 2021; Xu et al., in press). For these reasons, we removed Q3.

After removing Q3, the 19-item unidimensional model was tested. The fit of this model was similar to the fit of the 20-item model: Chi-square (152) = 275.841, $p < .0001$, RMSEA = .046, 90% CI [.037, .054], SRMR = .043, CFI = .939,

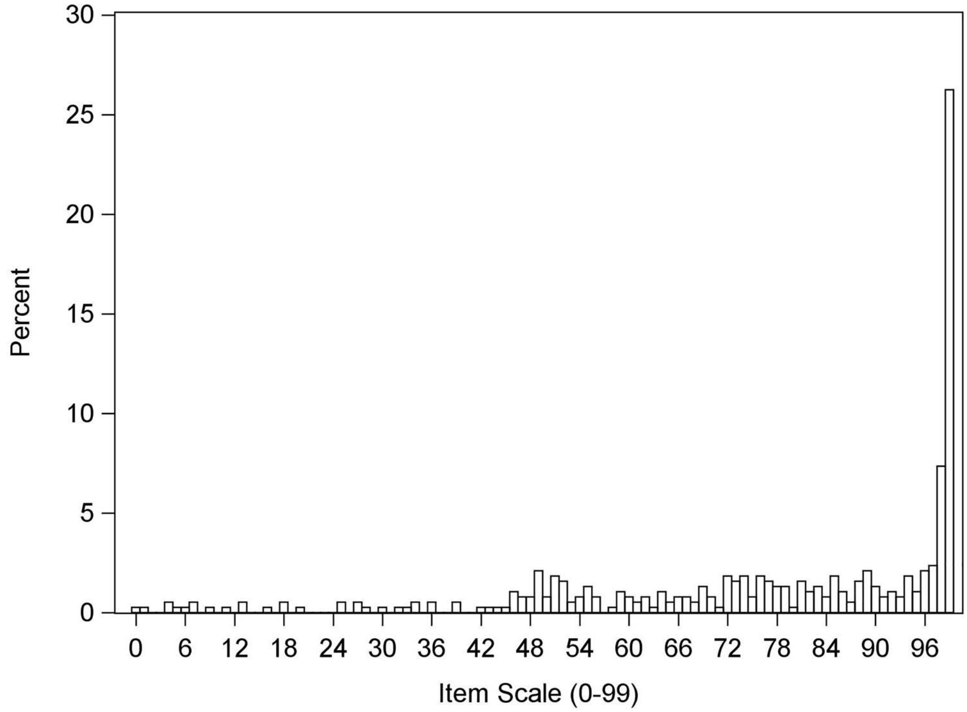


**Figure 1.** Example item distribution for Q4 ("I consider many possibilities when I make plans for my future") in the SDI:SR ASL group.

and TLI = .931. Although no extreme MIs were observed, multiple significant values were identified. The sensitivity check, conducted on the 19-item model with 15 MI-based iterative alterations, produced similar results to those of the sensitivity check for the 20-item model. Thus, as some fit indices were within the acceptable range and as the impact of misfit on loading estimates due to omitted error correlations was low, we treated the fit of the unmodified 19-item model as acceptable. Furthermore, in this model, standardized loadings, on average, were .654 (SD = .072), ranging from .535 to .779. All standardized loadings and their standard errors are presented in Table 4. Considering the acceptable model fit and the absence of low standardized loadings, we tentatively accepted the 19-item unidimensional structure as the internal structure of the SDI:SR ASL.

Overall, with a series of CFA analyses, we tentatively concluded that the SDI:SR ASL has a unidimensional internal structure. The 19 retained items all had substantial loadings on the factor, as indicated by medium-to-large standardized loadings. Yet, the fit of the model was only acceptable, as local misfit was found in multiple parts of the model. Thus, the results for Research Question 1.2 provided preliminary evidence for the claim that the SDI:SR ASL has an established internal structure.

*Research question 1.3*

Omega total, based on the 19-item model, was .934. Thus, the results for Research Question 1.3 provided strong evidence for the claim that scores on the SDI:SR ASL are internally consistent.

**Table 4.** Standardized loadings of the final 19-item model in the SDI:SR ASL group

| Item | Standardized loading | |
|---|---|---|
| | Estimate[a] | SE |
| Q1 | 0.536 | 0.043 |
| Q2 | 0.562 | 0.051 |
| Q4 | 0.659 | 0.038 |
| Q5 | 0.660 | 0.040 |
| Q6 | 0.596 | 0.040 |
| Q7 | 0.728 | 0.035 |
| Q8 | 0.702 | 0.034 |
| Q9 | 0.726 | 0.032 |
| Q10 | 0.535 | 0.046 |
| Q11 | 0.669 | 0.041 |
| Q12 | 0.754 | 0.039 |
| Q13 | 0.629 | 0.043 |
| Q14 | 0.619 | 0.045 |
| Q15 | 0.629 | 0.046 |
| Q16 | 0.596 | 0.043 |
| Q17 | 0.662 | 0.038 |
| Q19 | 0.644 | 0.045 |
| Q20 | 0.743 | 0.038 |
| Q21 | 0.779 | 0.023 |

Note. [a]All standardized loadings are statistically significant ($p < .001$). SE = Standard Error.

## Part 2: SDI:SR ASL and SDI:SR

In Part 2, we report the results for the analyses on the sample that included the SDI:SR ASL, SDI:SR Disability, and SDI:SR No Disability groups. To determine if the multigroup analyses were warranted, we investigated characteristics of the retained 19 items across the SDI:SR ASL, SDI:SR Disability, and SDI:SR No Disability groups. We also tested the unidimensional internal structure of the 19-item SDI:SR, found in Part 1, on the combined sample. Next, we evaluated validity evidence for measurement invariance of the SDI:SR across the SDI:SR ASL, SDI:SR Disability, and SDI:SR No Disability groups.

### *Preprocessing*

#### Item Characteristics

An investigation of descriptive statistics across groups (see Supplementary Table 1) showed that item distributions in the SDI:SR Disability and SDI:SR No Disability groups, similarly to the SDI:SR ASL group, were negatively skewed. The highest response option in the SDI:SR Disability and SDI:SR No Disability groups was also selected substantially more commonly than other response options. Across all 21 items, the average percentages of participants selecting the highest response option in the SDI:SR Disability and SDI:SR No Disability groups were 21.40% (SD = 4.76) and 25.62% (SD = 6.39), with a maximum of 33.10% and 42.47% for Q3 (“I choose what my room looks like”), respectively. Item correlations between the retained 19 items tended to be higher in the SDI:SR Disability group (mean = .497, SD = .076, minimum = .295, maximum = .652) than in the SDI:SR ASL group (mean = .426, SD = .079, minimum = .208, maximum = .652), which in turn tended to be higher than in the SDI:SR No Disability group (mean = .375, SD = .090, minimum = .172, maximum = .639). In sum, we found some deviations from expected item characteristics in the SDI:SR Disability and SDI:SR No Disability groups, similar to those in the SDI:SR ASL group (e.g., negative item skews). Furthermore, although differences were found in the magnitude of item correlations across groups, these differences were not so dramatic as to prohibit proceeding with the analysis.

#### Internal Structure

The 19-item unidimensional model tested on the entire sample showed the following fit: Chi-square (152) = 1261.189, $p < .0001$, RMSEA = .047, 90% CI [.045, .049], SRMR = .034, CFI = .931, and TLI = .923. As was the case in the model that only included youth that took the SDI:SR ASL, RMSEA and SRMR were within the acceptable range, whereas the Chi-square test, CFI, and TLI suggested poor fit. The largest significant MI was again observed for the expected error correlation between Q16 and Q17 (.292). To determine if the MIs were substantial enough for the ignored misfit to lead to distorted estimates of standardized loadings, we again conducted a sensitivity check. Comparing standardized loadings of the model with no error correlations to those of a well-fitting model with 56 error correlations (Chi-square [96] = 117.756, $p = .065$), we found that the differences were small and, hence, inconsequential to model interpretations. Specifically, the absolute value of the differences, on average, was .017 (SD = .010), with a maximum of .037. Thus, as some fit indices were within the acceptable range and as the impact of misfit on loading estimates due to omitted error correlations was low, we treated the fit of the unmodified 19-item model as acceptable. Furthermore, standardized loadings, on average, were .634 (SD = .091), ranging from .420 to .784. All standardized loadings and their standard errors are presented in Supplementary Table 2. Although the standardized loading of .420 (Q1, “I plan weekend activities I like to do”) is lower than the next lowest standardized loading .540 (Q2 “I choose activities I want to do”), we decided to keep Q1 for the purposes of the multigroup analyses. Although the relative difference between these standardized loadings was very similar to the difference between the removed Q3 and the next lowest loading in Part 1, upon inspection, there was no conceptual justification for removal of Q1. Thus, considering the acceptable model fit and the absence of particularly low standardized loadings, we tentatively accepted the 19-item unidimensional structure as the structure for the entire sample and proceeded to the multigroup analyses.

### *Research question 2.1*

Model fit results for the measurement invariance testing are presented in Table 5. The fit of the configural invariance model was acceptable according to RMSEA and SRMR but poor according to the Chi-square test, CFI, and TLI. The largest MIs in the SDI:SR ASL and SDI:SR No Disability groups suggested expected error correlations between Q16 and Q17 of .254 and .299, respectively. Although an error correlation between Q16 and Q17 (.276) was also suggested in the SDI:SR Disability group, the largest MI was found for the expected error correlation of .286 between Q17 and Q21 (“I am able to focus to reach my goals”). A sensitivity check was again conducted to determine if the MIs were substantial enough for the ignored misfit to lead to distorted estimates of standardized loadings. Comparing standardized loadings of the model with no error correlations to those of a well-fitting model with 55, 13, and 9 error correlations in the SDI:SR No Disability group, SDI:SR ASL, and SDI:SR Disability groups respectively (Chi-square (379) = 423.659, $p = .056$), we found that the differences were small and, hence, inconsequential to model interpretations. Specifically, the absolute value of the differences across groups, on average, was .011 (SD = .012), with a maximum of .058. Thus, as some fit indices were within the acceptable range and as the impact of misfit on loading estimates due to omitted error correlations was low, we tentatively accepted the configural invariance model.

The fit of the metric invariance model was statistically significantly worse than the fit of the configural invariance model. MIs for two items in the SDI:SR No Disability and SDI:SR ASL groups and for one item in the SDI:SR Disability group exceeded the 3.84 threshold, suggesting that loadings for three items are noninvariant. However, the expected standardized changes in the loadings were considered trivial, with the largest being −.031 for Q4 (“I consider many possibilities when I make plans for my

**Table 5.** Invariance testing

| Model | Chi square | df | Scaling correction factor | RMSEA, 90% CI | SRMR | CFI | TLI | Comparison Model | Chi-square difference | df difference | p |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Configural | 1706.519 | 456 | 1.5843 | 0.050 [.047, .052] | 0.039 | 0.923 | 0.913 | | | | |
| Metric | 1794.963 | 492 | 1.5427 | 0.049 [.047, .051] | 0.044 | 0.919 | 0.916 | Configural | 64.435 | 36 | 0.002 |
| Scalar | 1939.480 | 528 | 1.5048 | 0.049 [.047, .052] | 0.047 | 0.913 | 0.915 | Metric | 151.434 | 36 | < .001 |
| Equal means | 1968.596 | 530 | 1.5015 | 0.050 [.047, .052] | 0.051 | 0.911 | 0.914 | Scalar | 59.206 | 2 | < .001 |
| Equal variances | 2001.024 | 530 | 1.5047 | 0.050 [.048, .053] | 0.087 | 0.909 | 0.912 | Scalar | 62.512 | 2 | < .001 |
| Equal means: 0 1 | 194.625 | 529 | 1.5040 | 0.049 [.047, .052] | 0.047 | 0.913 | 0.915 | Scalar | 0.158 | 1 | 0.691 |
| Equal means: 1 2 | 1961.418 | 529 | 1.5031 | 0.050 [.047, .052] | 0.051 | 0.911 | 0.914 | Scalar | 49.014 | 1 | < .001 |
| Equal means: 0 2 | 1967.318 | 529 | 1.5022 | 0.050 [.047, .052] | 0.051 | 0.911 | 0.914 | Scalar | 284.201 | 1 | < .001 |
| Equal variances: 0 1 | 1946.530 | 529 | 1.5048 | 0.049 [.047, .052] | 0.055 | 0.912 | 0.915 | Scalar | 7.050 | 1 | 0.008 |
| Equal variances: 1 2 | 1954.703 | 529 | 1.5046 | 0.049 [.047, .052] | 0.063 | 0.912 | 0.914 | Scalar | 16.095 | 1 | < .001 |
| Equal variances: 0 2 | 1998.682 | 529 | 1.5047 | 0.050 [.048, .053] | 0.084 | 0.909 | 0.912 | Scalar | 61.221 | 1 | < .001 |

*Note.* 0 = the SDI:SR No Disability group; 1 = the SDI:SR ASL group; 2 = the SDI:SR Disability group. Models with equality constraints placed on factor means or variances were based on the scalar model.

future") in the SDI:SR No Disability group, .112 also for Q4 in the SDI:SR ASL group, and −.095 for Q9 ("I think about each of my goals") in the SDI:SR Disability group. The alignment method did not identify noninvariant loadings. Thus, the metric invariance model was tentatively accepted.

The fit of the scalar invariance model was statistically significantly worse than the fit of the metric invariance model. MIs for nine items in the SDI:SR No Disability group, four items in the SDI:SR ASL group, and four items in the SDI:SR Disability group exceeded the 3.84 threshold, suggesting that intercepts for 11 items are noninvariant. However, the expected standardized changes in the intercepts were considered small, with the largest being −.035 for Q14 ("I keep trying even after I get something wrong") in the SDI:SR No Disability group, .199 for Q14 in the SDI:SR ASL group, and −.145 for Q19 ("I have what it takes to reach my goals") in the SDI:SR Disability group. The alignment method identified noninvariance in intercepts for one item: Q14. Specifically, for Q14, intercept noninvariance was found for the SDI:SR ASL group. Given the small number of noninvariant items and the small magnitude of noninvariance, we tentatively accepted the scalar invariance model.

Overall, with a series of multigroup CFA analyses, we tentatively concluded that measurement invariance holds for the SDI:SR ASL, SDI:SR Disability, and SDI:SR No Disability groups. However, the fit of the scalar invariance model was only acceptable, as local misfit was found in multiple parts of the model. In particular, there were small but nonnegligible error correlations, as well as noninvariant intercepts. Thus, the results for Research Question 2.1 provided some evidence for the claim that the SDI:SR ASL functions in the same way as the SDI:SR for adolescents with and without disabilities.

## Part 3

In Part 3, given the tenability of measurement invariance, we proceeded to the analysis of factor mean and variance differences across the SDI:SR ASL, SDI:SR Disability, and SDI:SR No Disability groups.

### *Research question 3.1*

Model fit results for Research Question 3.1 are presented in Table 5. The model with all factor means fixed to zero in the scalar invariance model fit statistically significantly worse than the scalar invariance model, suggesting the presence of differences in factor means between at least some groups. Testing of the models with pairwise equality constraints on factor means (with Bonferroni correction for family-wise type 1 error) identified statistically significant differences in factor means between the SDI:SR No Disability and SDI:SR Disability groups, as well as between the SDI:SR ASL and SDI:SR Disability groups, but no statistically significant difference between the SDI:SR No Disability and SDI:SR ASL groups. In the scalar model, the mean of the SDI:SR No Disability group was 0 (per the identification constraint), the mean of the SDI:SR ASL group was .020 (SE = .063), $p = .750$, and the mean of the SDI:SR Disability group was −.580 (SE = .095), $p < .001$, respectively. Similar results for significance of mean differences and for mean estimates were obtained using the alignment method. Thus, participants with disabilities who completed the SDI:SR, on average, scored lower than participants without disabilities who completed the SDI:SR and lower than deaf participants who completed the SDI:SR ASL. However, we did not detect a difference in self-determination between participants without disabilities who completed the SDI:SR and deaf participants who completed the SDI:SR ASL.

The model with all factor variances fixed to one in the scalar invariance model fit is statistically significantly worse than the scalar invariance model, suggesting the presence of differences in factor variances between at least some groups. Testing of the models with pairwise equality constraints on factor variances identified statistically significant differences between all groups. In the scalar model, the variance of the SDI:SR No Disability group was 1 (per the identification constraint), the variance of the SDI:SR ASL group was 1.296 (SE = .129), $p < .001$, and the variance of the SDI:SR Disability group was 2.241 (SE = .252), $p < .001$, respectively. Similar results for variance estimates were obtained using the alignment method. Thus, factor variance for participants with disabilities who completed the SDI:SR was larger than for deaf participants who completed the SDI:SR ASL, which was in turn larger than for participants without disabilities who completed the SDI:SR.

## Discussion

This paper describes the development, initial validation, and an application of the SDI:SR ASL Translation (SDI:SR ASL). The results provide preliminary support for the proposed interpretations and uses of the SDI:SR ASL and the assessment of self-determination in deaf adolescents, although more work is needed to fully support these interpretations and uses as well as develop the resources and tools to enable self-determination assessment information to be utilized in meaningful ways in the lives of deaf adolescents. In these initial validation activities, we found that the SDI:SR ASL functioned in similar ways to the original SDI:SR administered in American English with youth with and without disabilities. A one factor solution, consistent with research on the SDI:SR (Shogren et al., 2020) and other translation activities (Lachapelle et al., 2021; Shogren et al., 2019), best fit the data. Two items needed to be dropped from the SDI:SR ASL, a finding also replicated in other translated versions of the SDI:SR where cultural factors influence specific items.

Deaf youth who took the SDI:SR ASL scored comparably to youth without disabilities who took the SDI:SR, whereas youth with disabilities who took the SDI:SR scored lower than both groups. This finding may be due to the characteristics of our sample. The vast majority (over 80%) of deaf youth who took the SDI:SR ASL reported communicating directly at school or work. When deaf youth's environment consists of fully accessible, direct communication, opportunities for development of self-determination may be more comparable to youth without disabilities. The presence of communication barriers may obstruct opportunities for self-determination development. Future research should continue to explore the role of deaf youth's environments and communication preferences in the development of self-determination skills.

As another possibility to consider, deaf youth may have stronger self-determination skills that develop as a result of their experiences with navigating inaccessible environments in their lives, perhaps as one way resilience is expressed among deaf people (Zand & Pierce, 2011). Theoretically, self-determination skill development requires the opportunity to exercise these skills. If so, then it would suggest that the experience of being deaf—and having to consistently advocate for access and negotiate communication across multiple contexts—may mean deaf youth have more opportunities to develop self-determination skills. This may be a dimension of Deaf Gain, or the benefits that emerge among deaf people and deaf communities that are related to the experiences of being deaf (Bauman & Murray, 2014).

There are very few measures that are designed for use with deaf youth that are accessible via signed languages (e.g., Hoffmeister et al., 2015; Kushalnagar, Paludneviciene, et al., 2020). Availability of sufficient validity and reliability evidence to support the use of measures designed for deaf populations is critical. The SDI:SR ASL can be a valuable addition to assessment tools used with deaf youth in the transition process. For example, assessment results can be used to develop self-determination skill development goals in the Individualized Education Program (IEP) process, or to identify needs for preemployment transition services (pre-ETS) in the vocational rehabilitation process. And beyond a measurement perspective, community-based participatory research has demonstrated the value of self-determination in deaf communities (Garberoglio et al., 2020), further justifying the need for this measurement tool.

### Limitations and Future Research Directions

There are a number of limitations that must be considered in interpreting the findings. First, the extent to which deaf adolescents interacted with the translated videos in the SDI:SR ASL assessment is unknown. We know very little about how much students utilize accommodations in general, and ASL videos as accommodations, specifically (Cawthon, Winton, Garberoglio, & Gobble, 2011). ASL videos are typically presented alongside the English version of the test item, meaning that test takers are not wholly reliant on watching the video to have access to the information. They are also required to answer the test question in the English format, not in ASL via video, so the task necessarily requires the student to rely, in part, on the English version to answer the question. Eye tracking studies or watch-rewatch data might be able to capture their utilization of ASL videos, especially if the research is conducted alongside cognitive lab or other mechanism of collecting information on what strategies students are using (Measured Progress Innovation Lab, 2014). For example, students may first read the item, and then watch the video to confirm understanding. Alternatively, students may first watch the video, decide on their response, and then scan the written English item to answer accordingly. Continued work in this area should explore the extent to which deaf adolescents engaged with the ASL videos in the translated measure, and for what purpose. This should also explore how deaf adolescents' language proficiency in ASL and English may play a role in how they interact with this assessment.

Second, a high number of adolescents across all groups responded at the highest level on the scale, consistent with past findings in certain groups (Shogren et al., 2020). Ongoing work is needed to explore the reasons for this response pattern (e.g., students rounding to the boundary, rating scale not discriminating for adolescents with high levels of self-determination, distribution of self-determination is skewed in the population, etc.). Third, considering that measurement invariance was accepted only tentatively, future research can and should also explore alternative measurement models for the distribution of item responses, as well as the use of cognitive interviews to explore response processes and identify potential reasons for differences in responding across the SDI:SR ASL and SDI:SR. Fourth, research should replicate the findings with larger samples for the SDI:SR ASL and SDI:SR Disability groups. Specifically, larger sampling groups based on factors such as gender, communication preferences, race and ethnicity, additional disabilities, and deaf identity are needed to allow an examination of measurement invariance across diverse groups. Future work should also explore responding across the different versions of the assessment to determine if a particular modality (e.g., only written English, only ASL, both written English and ASL) is preferred by deaf youth.

Fifth, caution must be taken in generalizing results to target populations for two reasons. First, we did not have access to a random sample. Second, although restricting our sample to only include those who skipped no more than three items in the 21-item assessment increased data quality by removing "fake" data (e.g., someone testing out the system), it also means these results must be cautiously generalized to cases with high rates of item-level missing data. Sixth, some of the data for the SDI:SR Disability and No Disability groups was generated by participants who were engaged with the assessment as part of research studies or implementation of self-determination interventions in schools. Although the first data point for each participant was used, prior exposure to self-determination intervention was unknown for all participants. Thus, as SDI:SR scores of participants in Disability and No Disability groups could have been affected by previous exposure to self-determination intervention, the results about latent mean differences should be interpreted with caution.

Seventh, we did not account for clustering in our analysis. Data for the SDI:SR Disability and SDI:SR No Disability groups were primarily collected in schools, meaning there is clustering of student-level data within schools; the same could be true for the SDI:SR ASL group although we did not collect this information. For this reason, we did not include a clustering variable or offset standard errors as we might have if such data had been complete. Consequently, standard errors and results of significant tests should be approached with caution.

Finally, the primary focus of this study was to examine the psychometric quality of the SDI:SR ASL; ongoing work is needed to further examine the validity evidence for the proposed uses of the tool, particularly to inform educational planning related to self-determination instruction and to document self-determination outcomes in research.

## Conclusions

This paper describes the development of the SDI:SR ASL Translation (SDI:SR ASL) and reports the first reliability and validity analysis of this translated measure. This analysis provides preliminary support for the use of this measure to assess self-determination among deaf adolescents. It also explores how the reliability and validity evidence of the SDI:SR ASL compares to the original SDI:SR administered in American English as well as differences in self-determination levels across deaf students who take the SDI:SR ASL and hearing students with and without disabilities who take the SDI:SR. Findings suggest that deaf youth's self-determination scores may be more similar to hearing youth without disabilities than hearing youth with disabilities. The SDI:SR ASL is an important tool for researchers to better understand the self-determination of deaf youth, and for practitioners to assess and facilitate self-determination development among deaf youth.

## Supplementary Data

Supplementary material is available at *Journal of Deaf Studies and Deaf Education*.

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## References

AERA, APA, & NCME (2014). *Standards for educational and psychological testing*. American Educational Research Association.

Asparouhov, T., & Muthén, B. (2014). Multiple-group factor analysis alignment. *Structural Equation Modeling: A Multidisciplinary Journal*, **21**(4), 495–508. https://doi.org/10.1080/10705511.2014.919210.

Barnett, S., McKee, M., Smith, S. R., & Pearson, T. A. (2011). Deaf sign language users, health inequities, and public health: Opportunity for social justice. *Preventing Chronic Disease*, **8**(2), A45.

Bauman, H. D. L., & Murray, J. J. (Eds.) (2014). *Deaf gain: Raising the stakes for human diversity*. University of Minnesota Press.

Bocell, F. (2015). *The impact of unmodeled error covariance on measurement models in structural equation modeling* (Doctoral dissertation, University of Washington). *Research Works Archive*. digital.lib.washington.edu/researchworks/handle/1773/33773.

Bollen, K. A., & Lennox, R. (1991). Conventional wisdom on measurement: A structural equation perspective. *Psychological Bulletin*, **110**(2), 305–314. https://doi.org/10.1037/0033-2909.110.2.305.

Boudreault, P. (2005). Deaf interpreters. In Janzen, T. (Ed.) *Topics in signed language interpreting: Theory and practice* (pp. 323–353). John Benjamins. https://doi.org/10.1075/btl.63.

Braun, D. C., Gormally, C., & Clark, D. M. (2017). The deaf mentoring survey: A community cultural wealth framework for measuring mentoring effectiveness with underrepresented students. *CEB Life Sciences Education*, **16**(1), art10. https://doi.org/10.1187/cbe.15-07-0155.

Brown, T. A. (2015). *Confirmatory factor analysis for applied research* (2nd Ed.). Guilford Publications.

Byrne, B. M., Shavelson, R. J., & Muthén, B. (1989). Testing for the equivalence of factor covariance and mean structures: The issue of partial measurement invariance. *Psychological Bulletin*, **105**(3), 456–466. https://doi.org/10.1037/0033-2909.105.3.456.

Cawthon, S. W., Ho, E., Patel, P., Puja, G., Potvin, D. C., & Trundt, K. M. (2009). Multiple constructs and effects of accommodations on accommodated test scores for students with disabilities. *Practical Assessment, Evaluation, and Research*, **14**(21), Article 18. https://doi.org/10.7275/ktkv-327.

Cawthon, S., Winton, S., Garberoglio, C., & Gobble, M. (2011). The effects of American sign language as an assessment accommodation for students who are deaf or hard of hearing. *The Journal of Deaf Studies and Deaf Education*, **16**(2), 198–211.

Enders, C. K., & Baraldi, A. N. (2018). Missing data handling methods. In P. Irwing, T. Booth & D. J. Hughes (Eds.), *The Wiley handbook of psychometric testing: A multidisciplinary reference on survey, scale and test development* (pp. 139–185). John Wiley and Sons.

Garberoglio, C. L., Guerra, D. H., Sanders, G. T., & Cawthon, S. W. (2020). Community-driven strategies for improving postsecondary outcomes of deaf people. *American Annals of the Deaf*, **165**(3), 369–392. https://doi.org/10.1353/aad.2020.0024.

Garberoglio, C. L., Schoffstall, S., Cawthon, S., Bond, M., & Caemmerer, J. M. (2017). The antecedents and outcomes of autonomous behaviors: Modeling the role of autonomy in achieving sustainable employment for deaf young adults. *Journal of Developmental and Physical Disabilities*, **29**(1), 107–129. https://doi.org/10.1007/s10882-016-9492-2.

Garberoglio, C. L., Schoffstall, S., Cawthon, S., Bond, M., & Ge, J. (2014). The role of self-beliefs in predicting postschool outcomes for deaf young adults. *Journal of Developmental and Physical Disabilities*, **26**(6), 667–688. https://doi.org/10.1007/s10882-014-9388-y.

Graybill, P., Aggas, J., Dean, R. K., Demers, S., Finigan, E. G., & Pollard, R. Q. Jr. (2010). A community-participatory approach to adapting survey items for deaf individuals and American sign language. *Field Methods*, **22**(4), 429–448.

Hansen, E., Loew, R., Laitusis, C., Kushalnagar, P., Pagliaro, C., & Kurz, C. (2018). Usability of American sign language videos for presenting mathematics assessment content. *The Journal of Deaf Studies and Deaf Education*, **23**(3), 284–294. https://doi.org/10.1093/deafed/eny008.

Henner, J., Novogrodsky, R., Reis, J., & Hoffmeister, R. (2018). Recent issues in the use of signed language assessments for diagnosis of language disorders in signing deaf and hard of hearing children. *The Journal of Deaf Studies and Deaf Education*, **23**(4), 307–316. https://doi.org/10.1093/deafed/eny014.

Higgins, J., Famularo, J., Cawthon, S., Kurz, C., Reis, J., & Moers, L. (2016). Development of American sign language guidelines for K-12 academic assessments. *The Journal of Deaf Studies and Deaf Education*, **21**(4), 383–393. https://doi.org/10.1093/deafed/enw051.

Hoffmeister, R., Fish, S., Benedict, R., Henner, J., Novogrodsky, R., & Rosenburg, P. (2015). *American sign language assessment instrument (ASLAI): Revision 4*. Boston University Center for the Study of Communication and the Deaf.

Hu, L. T., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal*, **6**(1), 1–55. https://doi.org/10.1080/10705519909540118.

International Test Commission. (2017). *The ITC guidelines for translating and adapting tests* (2nd Ed.). International Test Commission. www.InTestCom.org.

Kane, M. T. (2013). Validating the interpretations and uses of test scores. *Journal of Educational Measurement*, **50**(1), 1–73. https://doi.org/10.1111/jedm.12000.

Kane, M. T. (2015). Validation strategies: Delineating and validating proposed interpretations and uses of test scores. In S. Lane, M. R. Raymond & T. M. Haladyna (Eds.), *Handbook of test development* (pp. 80–96). Routledge.

Kushalnagar, P., Harris, R., Paludneviciene, R., & Hoglind, T. (2017). Protocol for cultural adaptation and linguistic validation of health information National Trends Survey in American sign language (HINTS-ASL). *Journal of Medical Internet Research Protocols*, **6**(9), e8067. https://doi.org/10.2196/jmir.8067.

Kushalnagar, P., Paludneviciene, R., Kallen, M., Atcherson, S., & Cella, D. (2020). PROMIS-deaf profile measure: Cultural adaptation and psychometric validation in American sign language. *Journal of Patient-Reported Outcomes*, **4**(1), 44. https://doi.org/10.1186/s41687-020-00208-7.

Kushalnagar, P., Ryan, C., Paludneviciene, R., Spellun, A., & Gulati, S. (2020). Adverse childhood communication experiences associated with an increased risk of chronic diseases in adults who are deaf. *American Journal of Preventive Medicine*, **59**(4), 548–554.

Lachapelle, Y., Lussier-Desrochers, D., Gerasimova, D., Shogren, K. A., Hagiwara, M., Petitpierre, G., … Hicks, T. A. (2021). *Preliminary reliability and validity of the self-determination inventory: Student report French translation*. Manuscript in press.

Luckner, J. L., & Becker, S. J. (2013). Fostering skills in self-advocacy: A key to access in school and beyond. *Odyssey: New Directions in Deaf Education*, **14**, 34–38.

Luckner, J., & Sebald, A. (2013). Promoting self-determination of students who are deaf or hard of hearing. *American Annals of the Deaf*, **158**(3), 377–386.

McNeish, D. (2018). Thanks coefficient alpha, we'll take it from here. *Psychological Methods*, **23**(3), 412–433. https://doi.org/10.1037/met0000144.

Measured Progress Innovation Lab & Maryland State Department of Education (2014). *Guidelines for the Development of American Sign Language Versions of Academic Test Content for K-12 Students*. Retrieved October 10, 2021 www.measuredprogress.org/wp-content/uploads/2015/08/GAAP-ASL-Guidelines.pdf.

Millen, K. M. (2020). *Exploring self-determination scores in youth and young adults who are deaf or hard of hearing (Doctoral dissertation, University of Northern Colorado)*. www.proquest.com/docview/2424510032/abstract/247B6343D2294086PQ/1.

Millen, K., Dorn, B., & Luckner, J. L. (2019). Friendships and self-determination among students who are deaf or hard of hearing. *American Annals of the Deaf*, **163**(5), 576–595.

Mplus. (n.d.). *Chi-square difference testing using the Satorra-Bentler scaled Chi-square*. Retrieved October 10, 2020 www.statmodel.com/chidiff.shtml.

Mumbardó-Adam, C., Guàrdia-Olmos, J., Giné, C., Raley, S. K., & Shogren, K. A. (2017). The Spanish version of the self-determination inventory student report: Application of item response theory to self-determination measurement. *Journal of Intellectual Disability Research*, **62**(4), 303–311. https://doi.org/10.1111/jir.12466.

Muthén, L. K., & Muthén, B. O. (2019). *Mplus user's guide* (8th Ed.). Muthén & Muthén.

National Deaf Center. (2018). *Root causes of gaps in postsecondary outcomes for deaf individuals*. National Deaf Center on Postsecondary Outcomes, The University of Texas at Austin. www.nationaldeafcenter.org/rootcauses.

Nunnally, J. C., & Bernstein, I. H. (1994). *Psychometric theory*. McGraw-Hill.

Oakland, T. (2009). How universal are test development and use? In E. L. Grigorenko (Ed.), *Multicultural Psychoeducational Assessment* (pp. 1–40). Springer.

Ortiz, S. O., Ochoa, S. H., & Dynda, A. M. (2012). Testing with culturally and linguistically diverse populations: Moving beyond the verbal-performance dichotomy into evidence-based practice. In D. P. Flanagan & P. L. Harrison (Eds.), *Contemporary intellectual assessment: Theories, tests and issues* (3rd Ed.), pp. 526–552). Guilford Press.

Palmer, J. L., Newman, L. A., Davidson, S., & Cawthon, S. W. (2020). Life after college: Employment, social, and community outcomes for young deaf adults. *American Annals of the Deaf*, **165**(4), 401–417. https://doi.org/10.1353/aad.2020.0027.

Raley, S. K., Shogren, K. A., Rifenbark, G. G., Anderson, M. H., & Shaw, L. A. (2019). Comparing the impact of online and paper-and-pencil administration of the self-determination inventory: Student report. *Journal of Special Education Technology*, **35**(3), 133–144. https://doi.org/10.1177/0162643419854491.

Reynolds, M. (2020). *Deaf education elementary teachers' perceptions on self-determination: A mixed methods study (Doctoral dissertation, University of Oklahoma)*.

Roberts, S., Wright, B., Moore, K., Smith, J., Allgar, V., Tennant, A., ... Phillips, H. (2015). Translation into British sign language and validation of the strengths and difficulties questionnaire. *Health Technology Assessment Report. National Institute for Health Research Journals Library, Health Services and Delivery Research* No. 3.2. https://doi.org/10.3310/hsdr03020.

Russell, M., Kavanaugh, M., Masters, J., Higgins, J., & Hoffmann, T. (2009). Computer-based signing accommodations: Comparing a recorded human with an avatar. *Journal of Applied Testing Technology*, **10**(3), 1–20. www.jattjournal.com/index.php/atp/article/view/48358.

SAS/STAT 14.1 User's Guide. (2015). SAS Institute Inc.

Schafer, J. L., & Graham, J. W. (20022002). Missing data: Our view of the state of the art. *Psychological Methods*, **7**(2), 147–177. https://doi.org/10.1037/1082-989X.7.2.147.

Schoffstall, S., & Cawthon, S. (2013). *From theory to practice: Self-advocacy skill development of students who are deaf or hard-of-hearing who are transitioning into post-secondary settings*. Postsecondary Education Programs Network (Pepnet2). www.nationaldeafcenter.org/self-advocacy-transition.

Shogren, K. A. (2011). Culture and self-determination: A synthesis of the literature and directions for future research and practice. *Career Development for Exceptional Individuals*, **34**(2), 115–127. https://doi.org/10.1177/0885728811398271.

Shogren, K. A., Little, T. D., Grandfield, E., Raley, S. K., Wehmeyer, M. L., Lang, K. M., & Shaw, L. A. (2020). The self-determination inventory-student report: Confirming the factor structure of a new measure. *Assessment for Effective Intervention*, **45**(2), 110–120. https://doi.org/10.1177/1534508418788168.

Shogren, K. A., & Shaw, L. A. (2016). The role of autonomy, self-realization, and psychological empowerment in predicting early adulthood outcomes for youth with disabilities. *Remedial and Special Education*, **37**(1), 55–62. https://doi.org/10.1177/0741932515585003.

Shogren, K. A., Shaw, L. A., & Mumbardó-Adam, C. (2019). The assessment of self-determination in Spanish and American adolescents: The self-determination inventory: Student report. *Intellectual and Developmental Disabilities*, **57**(4), 274–288. https://doi.org/10.1352/1934-9556-57.4.274.

Shogren, K. A., Shaw, L. A., Raley, S. K., & Wehmeyer, M. L. (2018a). Exploring the effect of disability, race/ethnicity, and socioeconomic status on scores on the self-determination inventory: Student report. *Exceptional Children*, **85**(1), 10–27. https://doi.org/10.1177/0014402918782150.

Shogren, K. A., Shaw, L. A., Raley, S. K., & Wehmeyer, M. L. (2018b). The impact of personal characteristics on scores on the self-determination inventory: Student report in adolescents with and without disabilities. *Psychology in the Schools*, **55**(9), 1013–1026. https://doi.org/10.1002/pits.22174.

Shogren, K. A., & Ward, M. J. (2018). Promoting and enhancing self-determination to improve the post-school outcomes of people with disabilities. *Journal of Vocational Rehabilitation*, **48**(2), 187–196.

Shogren, K. A., Wehmeyer, M. L., & Lane, K. L. (2016). Embedding interventions to promote self-determination within multi-tiered systems of supports. *Exceptionality*, **24**(4), 213–224. https://doi.org/10.1080/09362835.2015.1064421.

Shogren, K. A., Wehmeyer, M. L., Palmer, S. B., Forber-Pratt, A. J., Little, T. J., & Lopez, S. (2015). Causal agency theory: Reconceptualizing a functional model of self-determination. *Education and Training in Autism and Developmental Disabilities*, **50**(3), 251. https://doi.org/10.1007/978-94-024-1042-6_5.

Shogren, K. A., Wehmeyer, M. L., Palmer, S. B., Forber-Pratt, A. J., Little, T. J., & Seo, H. (2017). Preliminary validity and reliability of scores on the self-determination inventory: Student report version. *Career Development and Transition for Exceptional Individuals*, **40**, 92–103. https://doi.org/10.1177/2165143415594335.

Shogren, K. A., Wehmeyer, M. L., Palmer, S. B., Rifenbark, G. G., & Little, T. D. (2015). Relationships between self-determination and postschool outcomes for youth with disabilities. *Journal of Special Education*, **53**, 30–41. https://doi.org/10.1177/0022466913489733.

Wehmeyer, M. (1992). Self-determination: Critical skills for outcome-oriented transition services. *Journal for Vocational Special Needs Education*, **15**(1), 3–7.

Willis, G. B. (2004). *Cognitive interviewing: A tool for improving questionnaire design*. Sage Publications.

Xu, T., Qian, X., Rifenbark, G., & Shogren, K. A. (in press). *Psychometric properties of self-determination inventory: Student report among Chinese students with and without intellectual and developmental disabilities*.

Zand, D. H., & Pierce, K. J. (Eds.) (2011). *Resilience in deaf children: Adaptation through emerging adulthood*. Springer Science & Business Media.